TECHNICAL NOTE

HIDE PULLER DAMAGE AND THE VERTICAL FIBER DEFECT*

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Introduction

One of the many ways of increasing efficiency in the meat packing industry has been the substitution of hide pulling machines for the old method of hand flaying with knives. Several distinctly different types of machines and procedures have been developed for hide removal (1). It was estimated in 1972 (2) that 75 percent of United States hides were removed with pullers. This has resulted in a general improvement in hide quality due to a significant decrease in butcher cuts. However, this procedure, especially with the newer "down puller," can exert so much force that it could cause considerable grain-crack damage at various hide locations. This damage ("grain break") was described and illustrated in a pamphlet issued by the Tanners' Hide Bureau in 1972 (3). Tancous (4, 5) also pointed out that, while hide pulling machines greatly reduced the damage from flay cuts, they may introduce new damage from grain cracks. Proper handling and adjustment of machines have been shown to minimize this problem.

Some packers and hide dealers feel that hides identified as Hereford by their hair color may be the most troublesome in this respect. If so, then perhaps the weakness caused by the vertical fiber defect (6), which occurs most frequently in these Hereford-type hides, may be responsible. A packer with this thought in mind offered to cooperate with us to obtain further information.

Experimental

A large Midwest packer, who prefers to remain anonymous, supplied preliminary samples from hides suspected of showing puller damage. The plan was to select a number of brined hides identified as Hereford-type by their hair color, coming from the down-puller, clip the hair from the butt area on the left side, and inspect the clipped area for grain breaks. Hides showing damage would be reserved for sampling until about 100 had been accumulated. Sample panels

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(12–18 in. long and 8–12 in. wide) were cut from the left sides in the backbone-tail corner of 25 hides selected in this manner over a period of several months, and were shipped to this laboratory for microscopic evaluation of fiber structure (6). Our hope of accumulating about 100 hides did not materialize.

When it was found that 11 of the 25 samples had the vertical fiber defect in the forward end of the panels, the selected hides were purchased for experimental study in more detail. After the hides were sided and each side was identified with punched numerals, the 50 sides were shipped to a cooperating tanner for processing to the unsplit blue stage and were then returned. All sides were closely examined and graded for occurrence of grain cracks (3) representing puller damage. The left sides were again sampled, this time in the area immediately in front of the brined samples.

The blue sides were then shipped back to the same tanner for processing to the unbuffed crust stage for 4½–5½ oz shoe upper leather. The left sides were again sampled, in the area immediately in front of the blue samples, for physical testing. The right sides were similarly tested at corresponding locations. Each side was thus classified with respect to: 1) fiber defect, 2) puller damage, and 3) leather weakness, and the results were compared to indicate whether the defect and/or weakness were correlated with the occurrence of puller damage.

Results and Discussion

Results of assessments of puller damage and strength of crust leather for the 11 hides with defective fiber structure are shown in Table I. Corresponding data for the 14 hides with normal fiber structure appear in Table II. It is apparent that 11 (50 percent) of the 22 defective sides suffered puller damage, none of which was severe, whereas 20 (71 percent) of the 28 normal sides were damaged and nine of these (32 percent) suffered severe damage. Despite the attempt to select only damaged hides, seven hides showed no evidence of grain crack and four of these (57 percent) had defective fiber structure. Four other hides showed severe damage to both sides and all of these had normal structure. In general, grain cracks occurred at many different hide locations, but the longer cracks tended to run diagonally across the butt area, or occasionally, at the shoulder.

With respect to side weakness, as measured by tensile strength of resultant crust leather, the data indicate that the nine sides showing severe puller damage had an average tensile strength of 2331 lb/in.^{2}, and the 22 sides with slight to moderate damage had an average strength of 1458 lb/in.^{2}. The corresponding value for the 19 undamaged sides was only 1593. Therefore, puller damage was unrelated to side weakness.

The results are summarized in Table III according to occurrence of hide puller damage, the vertical fiber defect, and leather strength in the selected hides, rather than in the individual sides. It is apparent that more (44 percent) of the hides

TABLE I

DEFECTIVE SIDES: PULLER DAMAGE AND LEATHER STRENGTH

Hide No.	Fiber Structure*	Puller Cracks†		Tensile Strength (lb/sq in.)‡		
		Left	Right	Left	Right	Average
1	V	+	○	575	930	753
2	I	○	+	1095	1105	1100
4	I	+	+	1430	1205	1318
5	V	+	+	525	790	658
12	I	○	○	1130	1335	1233
14	V	○	○	950	975	963
15	I	○	+	890	1120	1005
18	I	+	+	810	1265	1038
21	V	+	+	600	850	725
22	V	○	○	1140	1075	1108
25	V	○	○	1065	1195	1130
Sides cracked		5/11	6/11			
Severe cracks		0	0			

*Classified from cross sections: N = normal; I = intermediate form of vertical fiber defect; V = extreme (vertical) form of defect.

†Grain breaks from hide puller: ○ = none; + = slight to moderate damage from relatively few short cracks; ++ = severe damage from numerous cracks, many of them long.

‡Average for duplicate specimens cut parallel to backbone from forward — butt location of crust upper leather.

TABLE II

NORMAL SIDES: PULLER DAMAGE AND LEATHER STRENGTH*

Hide No.	Fiber Structure	Puller Cracks		Tensile Strength (lb/sq in.)		
		Left	Right	Left	Right	Average
3	N	○	+	1725	1455	1590
6	N	++	++	1630	2985	2308
7	N	+	+	1570	3125	2348
8	N	+	+	1665	1750	1708
9	N	+	+	1630	2180	1905
10	N	○	○	2490	3365	2928
11	N	○	○	1860	2585	2223
13	N	++	++	2185	2975	2580
16	N	○	○	1585	2165	1875
17	N	++	+	2545	3080	2813
19	N	+	+	1700	1845	1773
20	N	+	○	1805	2720	2263
23	N	++	++	2410	2610	2510
24	N	++	++	2010	1625	1817
Sides cracked		10/14	10/14			
Severe cracks		5	4			

*See Table I for explanations.

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10	N	○	○	2490	3365	2928
11	N	○	○	1860	2585	2223
13	N	++	++	2185	2975	2580
16	N	○	○	1585	2165	1875
17	N	++	+	2545	3080	2813
19	N	+	+	1700	1845	1773
20	N	+	○	1805	2720	2263
23	N	++	++	2410	2610	2510
24	N	++	++	2010	1625	1817
Sides cracked		10/14	10/14			
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TABLE III

LEATHER FROM SELECTED HIDES: PULLER DAMAGE AND DEFECT

Puller Effects	Fiber Structure*	Selected Hides		Average Tensile Strength*
		Number	% of Total	
Damaged	Normal	11	44	2147
	Defective	7	28	942
Undamaged	Normal	3	12	2342
	Defective	4	16	1109
Total	Normal	14	56	2189
	Defective	11	44	1003

*See Table I for explanations.

suffering puller damage had normal structure than had defective structure (28 percent), and more of the hides undamaged by pulling were defective structurally. Therefore, puller damage was unrelated to presence of the fiber defect. Tensile strength values confirm that weakness was related only to the defect in this test.

Since we examined only the "Hereford-type" hides identified as described earlier, we obtained no information on the prevalence of hide puller damage among different breed types including Herefords accurately identified by breeding records, but we did find strong evidence that the weakness caused by the vertical fiber defect was unrelated to this kind of hide damage. We must emphasize that this test was too small to provide a conclusive answer to the problem; further information could be gained by testing the strength of sides showing significant puller damage.

Acknowledgments

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Discussion

DR. EDWARD MELLON (Consultant): Al, we thank you for a very interesting paper. Are there any questions from the audience?

MR. DAVID SMALL (Transcontinental Leathers, Inc.): Over the past six months I have seen a great deal of the puller damage that you were describing, with enormous severity. If you conclude that you didn't relate the two defects, do you then conclude, as we had in our own minds, before you made the study, that the pulling equipment was mechanically at fault, by being improperly set?

MR. EVERETT: Yes, I got the impression from talking to others that adjustment of these pullers is a problem, and there are also different types of pullers; some are more prone to produce damage than others. I understand that the down-puller type is usually more troublesome and calls for more careful adjustment. Of course, we have no evidence of what other factors are involved.

MR. SMALL: Are there new types of equipment that are suddenly coming on stream? I have never seen the incidence of this defect so high.*

MR. EVERETT: There is an increased use of the pullers, and I do not know how many different types there are.

DR. DAVID BAILEY (Eastern Regional Research Center): The incidence of the grain crack is not a true incidence of the entire operation. These hides were specifically looked for and selected for hide puller damage. The hair was shaved off and if damage was seen, the hide was set aside. The damage was not visible with the hair in place. Thus, this group of 25 had a high incidence because they were picked out on evidence of damage. They were not a random sample.

MR. EVERETT: Dave Small, let me ask you a question. Have you any feeling as to what type of hide shows the most damage? Have you related it to hair color or other characteristic?

MR. SMALL: No, but I do think that it probably came from certain specific suppliers. I think one packer gave us the worst incidence, but then others would be occasional.

MRS. JEAN TANCOUS (Tanners' Council Laboratory): I want to ask Dave Small at what process steps he graded his leather. You can get cracks after setting out which can be confused with puller damage.

MR. SMALL: Jean, there was no possibility of confusion; it was there in the lime, in the blue. You could go to the unhairing paddle, pull out a hide and see huge cracks.

*Subsequent note from Mr. Small (October 1978): The incidence of severe mechanical damage along belly areas continues very high at this time. Evidently no progress on solving the problem has been made since this paper was presented. The loss in yield is significant, and it should warrant industry corrective action.

MRS. TANCOUS: I would also like to ask Al a question. You picked 25 hides out of a curing plant after you shaved them. Why did only 12 or 13 show cracks in the leather?

MR. EVERETT: They were selected on the basis of clipping the hair, and the individual picked the ones he thought had cracks. At that time they apparently weren't running very many, and they were leaning over backwards to give us 25 hides. I also got the impression from the packer that this may be seasonal, being worst in the fall. Our selection happened to be in the spring, although I can't see how that could be a factor.

MRS. TANCOUS: What did the individual see when he was pulling out hides that were cracked?

MR. EVERETT: It is hard to say.

DR. MELLON: Thank you, Al, for a very interesting paper.